PATENT ABSTRACTS OF JAPAN

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(22)Date of filing : 08.11.1994

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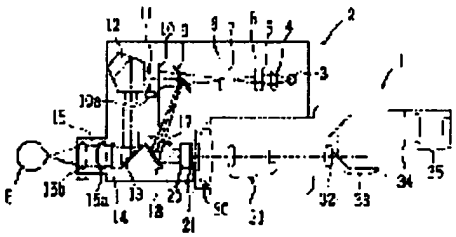
(72)Inventor : YANO NOBUYUKI

(54) SLIT LIGHT MICROSCOPE

(57)Abstract:
PURPOSE: To obtain a high-powered confocal scan image by leading a luminous flux reflected by an observation surface of an eye to be examined to an objective lens after it is image formed on a rotary disk.
CONSTITUTION: Light from a lighting light source 3 is converged by a condenser lens 4, and lights the rotary disk 10 through a beam splitter 9 after being made linear polarization by a polarizer 8. A luminous flux emitted from a pin hole of the rotary disk 10 forms many pin hole images on the observation surface of the eye to be examined E through the objective lens 15. The light of circular polarization scattered by the observation surface of the eye to be examined image forms on the rotary disk 10 through the objective lens 15, and the light transmitted through the pin hole of the disk 10 is reflected by the beam splitter 9, and after being reflected by a mirror 18, is separated to two luminous fluxes by a luminous flux division mirror 20, and goes toward the objective lens 30 of a slit light microscope 1 through a window glass 21, and an observer observes it through the optical system of the slit light microscope 1.



LEGAL STATUS

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[Number of appeal against examiner's decision of rejection]	

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[Date of extinction of right]

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CLAIMS

[Claim(s)]
[Claim 1] In the slit lamp microscope which has the slit illumination-light study system which carries out slit lighting of the optometry-ed, and the observation optical system containing the objective lens which observes the optometry-ed by which slit lighting was carried out The confocal scan microscope unit which has the light guide optical system which carries out a light guide in the account objective lens of back to front which made said rotating disc carry out image formation of the flux of light reflected in respect of observation examined the eyes to the illumination-light study system which carries out pinhole lighting of the examined the eyes observation side by the illumination light which illuminated the rotating disc with many pinholes and passed the rotating disc, The slit lamp microscope characterized by having an anchoring means to attach this confocal scan microscope unit in front of said objective lens.
[Claim 2] The anchoring means of claim 1 is a slit lamp microscope characterized by the ability to observe optometry-ed directly with said objective lens when it has the maintenance device in which said confocal scan microscope unit is held free [escape and insertion to an observation optical path] from an observation optical path and said confocal scan microscope unit escapes from an observation optical path.
[Claim 3] The maintenance device of claim 2 is a slit lamp microscope characterized by having a migration means to move to the rotation means or the upper part which said confocal scan microscope unit rotates.
[Claim 4] The light guide optical system of claim 1 is a slit lamp microscope characterized by having a flux of light separation means to divide the flux of light into two behind said rotating disc.
[Claim 5] The flux of light separation means of claim 4 is a slit lamp microscope characterized by changing a solid angle by consisting of two or more mirrors and changing the physical relationship of two or more of these mirrors.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the slit lamp microscope which observes optometry-ed, and relates to the still more detailed equipment in which confocal scan microscope observation is possible.
[0002]
[Description of the Prior Art] A slit lamp microscope projects slit light towards optometry-ed, is equipment which carries out expansion observation of the object part illuminated by this slit light by the stereomicroscope, and is widely used in the ophthalmology field. In observation by the conventional slit lamp microscope, when the optic media in an eye had turbidity, the slit light projected by this turbidity carried out scatter reflection, the flare was applied, and there was a case where it was difficult to obtain the clear image of an object part. As a microscope for obtaining a clear image except for the scattered light, the kino microscope indicated by U.S. Pat. No. 4884880 and 4927254 is known. The equipment which attached the confocal scan optical system of this kino microscope in the microscope head of a slit lamp microscope is proposed. This equipment converts a microscope head and inserts a confocal scan unit between the objective lens of a slit lamp microscope, and the binocular section.
[0003]
[Problem(s) to be Solved by the Invention] However, since the above-mentioned equipment needed to convert the microscope head, the existing slit lamp microscope had the fault of not being attached. Moreover, since the confocal scan unit of the above-mentioned equipment is prepared between an objective lens and the binocular section, it is difficult for it to make a high scale factor. However, in observation for a low scale factor, since the contrast rise effectiveness of an image is small, the profitableness of confocal observation will be reduced considerably.
[0004] This invention makes it a technical technical problem to offer the slit lamp microscope with which the confocal scan image of a high scale factor is obtained, without adding large reconstruction to a slit lamp microscope in view of the fault of equipment conventionally [above-mentioned].
[0005]
[Means for Solving the Problem] This invention is characterized by having the following configurations, in order to solve the above-mentioned technical problem.
(1) In the slit lamp microscope which has the slit illumination-light study system which carries out slit lighting of the optometry-ed, and the observation optical system containing the objective lens which observes the optometry-ed by which slit lighting was carried out The confocal scan microscope unit which has the light guide optical system which carries out a light guide in the account objective lens of back to front which made said rotating disc carry out image formation of the flux of light reflected in respect of observation examined the eyes to the illumination-light study system which carries out pinhole lighting of the examined the eyes observation side by the illumination light which illuminated the rotating disc with many pinholes and passed the rotating disc, It is characterized by having an anchoring means to attach this confocal scan microscope unit in front of said objective lens.

[0006] (2) The anchoring means of (1) is characterized by the ability to observe optometry-ed directly with said objective lens, when it has the maintenance device in which said confocal scan microscope unit is held free [escape and insertion to an observation optical path] from an observation optical path and said confocal scan microscope unit escapes from an observation optical path.
[0007] (3) The maintenance device of (2) is characterized by having a migration means to move to the rotation means or the upper part which said confocal scan microscope unit rotates.
[0008] (4) Light guide optical system of (1) is characterized by having a flux of light separation means to divide the flux of light into two behind said rotating disc.
[0009] (5) The flux of light separation means of (4) consists of two or more mirrors, and it is characterized by changing a solid angle by changing the physical relationship of two or more of these mirrors.
[0010]
[Example] Hereafter, one example of this invention is explained based on a drawing.
[Configuration of optical system] drawing 1 is drawing which looked at the optical system in the condition of being the schematic diagram showing the optical system of the equipment of an example, and having attached the confocal scan microscope unit 2 in the slit lamp microscope section 1, from width, and drawing 2 is drawing which looked at the optical system of drawing 1 from the top. In addition, although a slit lamp microscope is equipped with the slit illumination system which floodlights slit light to optometry-ed, since it puts on the location which is made to wind in this at the time of confocal scan observation, and does not become obstructive, the explanation is omitted.
[0011] (Confocal scan microscope unit) 3 is a source of the illumination light and 4 is a condensing lens. UV cut-off filter which cuts ultraviolet radiation with 5 [harmful to the optometry E-ed], and 6 are infrared cut-off filters which cut infrared light harmful to the optometry E-ed. 7 extracts, 8 is a polarizer and a polarizer 8 makes the illumination light from the light source 3 the linearly polarized light. 9 is a beam splitter. The optical system to the source 3 of the illumination light - a polarizer 8 is the optical system of an illumination system proper, and carries out coupling of an illumination system and the observation system by the beam splitter 9. 10 is a rotating disc with the pinhole of a large number spirally arranged considering a revolving shaft as a core, and is called the so-called Nipkow disk. The rotating disc 10 is located in the object side focus of the slit lamp microscope section 1 mentioned later. A rotating disc 10 carries out high-speed rotation by motor 10a.
[0012] 11 is Phi-RUDORENZU, 12 is a pentaprism and a pentaprism 12 carries out the operation which reverses an image. 13 is a mirror for changing an optical path. 14 is lambda/4 plate, and lambda/4 plate 14 changes into the light of the circular polarization of light the illumination light made into the linearly polarized light by the above-mentioned polarizer 8, and it changes the light of the circular polarization of light into the light of the linearly polarized light. 15 is an objective lens and an objective lens 15 establishes a rotating disc 10 and an examined the eyes observation side in a location [****]. An objective lens 15 consists of fixed lens 15a and migration lens 15b movable in the direction of an optical axis, and minute focal doubling can be performed by moving migration lens 15b.
[0013] 17 is an analyzer. The analyzer 17 is arranged so that the polarization shaft of a polarizer 8 and the polarization shaft may cross at right angles. Although the light of the circular polarization of light reflected in respect of observation changes to the linearly polarized light with lambda/4 plate 14, since polarization shaft orientation rotates 90 degrees with the illumination light at this time, an analyzer 17 can be passed. The reflected light in the front face of a rotating disc 10, Phi-RUDORENZU 11, and pentaprism 12 grade is altogether cut by the analyzer 17. 18 is a mirror.
[0014] 19 and 20 are flux of light division mirrors, and divide into two the flux of light reflected by the mirror 18. Thereby, a tester can do solid observation of the observation side examined [E] the eyes through the slit lamp microscope section 1. Moreover, since two flux of light division mirrors 20 change the solid angle of the 2 flux of lights divided by being movable to a longitudinal direction and changing physical relationship with the flux of light division mirror 19 with a knob

without illustration, the tester who looks into the slit lamp microscope section 1 can change a cubic effect. 21 is a windowpane.
[0015] (Slit lamp microscope section) 30 is an objective lens, behind the objective lens 30, the variable power lenses 31a and 31b, the image formation lenses 32a and 32b, the erecting prisms 33a and 33b, and field diaphragms 34a and 34b of a Uichi Hidari pair are arranged, and an observer observes the middle image formed in field diaphragms 34a and 34b with oculars 35a and 35b.
Three configurations of the attachment and detachment to a [attachment], next the slit lamp microscope section 1 of the confocal scan microscope unit 2 are explained based on drawing 3 .
[0016] As for what is shown in (a) of drawing 3 , posterior part 2a of the confocal scan microscope unit 2 is fixed to the lens-barrel of the slit lamp microscope section 1. Since a configuration exceptional in the configuration of this anchoring [itself] is unnecessary, that explanation is omitted. Anterior part 2b of the confocal scan microscope unit 2 of the slit lamp microscope section 1 is pivotable as a core, and a position suspends the revolving shaft shown by A to posterior part 2a according to a click device. At the time of slit lamp microscope observation, the optical path of the up to [from the front face of the objective lens 30 of the slit lamp microscope section 1] examined [E] the eyes is securable by locating unit anterior part 2b in the location shown by the dotted line.
[0017] Unit anterior part 2b can slide upward what is shown in (b) of drawing 3 to posterior part 2a. What is shown in (c) of drawing 3 can be rotated, as unit anterior part 2b makes a shaft 40 the center of rotation and an arrow head C shows.
[0018] The observation actuation is explained in the equipment of the above configurations. It is made to wind in a slit illumination system, the confocal scan microscope unit 2 is attached, and a confocal scan microscope unit is put on a confocal scan microscope observation location. If the power source of the confocal scan microscope unit 2 is switched on, while the source 3 of the illumination light will light up, motor 10a drives and a rotating disc 10 carries out high-speed rotation. It is condensed with a condensing lens 4, and the light from the source 3 of the illumination light is extracted through the UV cut-off filter 5 and the infrared cut-off filter 6, and condenses to 7. After light which carried out outgoing radiation of the drawing 7 is made into the linearly polarized light by the polarizer 8, it penetrates a beam splitter 9 and illuminates a rotating disc 10. It passes along Phi-RUDORENZU 11 and a pentaprism 12, it is reflected by the mirror 13, and the flux of light which carried out outgoing radiation of the pinhole of a rotating disc 10 changes the sense. The light of the linearly polarized light reflected by the mirror 13 forms many pinhole images in the observation side examined [E] the eyes through the objective lens group 15, after being changed into the circular polarization of light by passing along lambda/4 plate 14.
[0019] The light of the circular polarization of light scattered about in respect of observation examined the eyes changes to the linearly polarized light by passing along lambda/4 plate 14 again through the objective lens group 15, and the linearly polarized light is made into what those shaft orientations rotated 90 degrees to the illumination light at this time. Through a mirror 13, a pentaprism 12, and Phi-RUDORENZU 11, image formation of the light of this linearly polarized light can be carried out on a rotating disc 10, and it can pass along the pinhole on a rotating disc 10. It reflects by the beam splitter 9 and the light which passed through the pinhole of a disk 10 reaches an analyzer 17. Since the analyzer 17 is arranged so that the polarization shaft of a polarizer 8 and the polarization shaft may cross at right angles, the reflected light in the front face of a rotating disc 10, Phi-RUDORENZU 11, and pentaprism 12 grade is cut, and the light scattered about in respect of observation examined the eyes is passed.
[0020] After reflecting the light which passed along the analyzer 17 by the mirror 18, it is separated into the 2 flux of lights by the flux of light division mirrors 19 and 20, a windowpane 21 is passed, and a tester observes this through the optical system of the slit lamp microscope section 1 toward the objective lens 30 of the slit lamp microscope section 1. Although the light of only the field where the examined the eyes observation side illuminated by the pinhole on a rotating disc 10 was restricted passes through a pinhole again and reaches a tester eye, since a majority of these pinholes are spirally arranged on a rotating disc 10 and high-speed rotation of the rotating disc 10 is carried out by motor 10a, the whole examined the eyes observation side

will be scanned and a tester can observe the whole observation side. In addition, as for the rotational speed of the rotating disc 10 by motor 10a, it is desirable that it is more than the speed as which a tester eye does not sense a flicker by scan.

[0021]

[Effect of the Invention] As mentioned above, according to this invention, it can be easily used as a confocal scan microscope, without converting the existing slit lamp microscope. Moreover, it is not necessary to hurt the observation function which the attached slit lamp microscope has by moving a part of confocal scan microscope unit by this invention. Furthermore, since the confocal scan microscope unit of this invention has an original objective lens, it can obtain the confocal observation image of a high scale factor easily by replacing this objective lens with the thing of a high scale factor.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention relates to the slit lamp microscope which observes optometry-ed, and relates to the still more detailed equipment in which confocal scan microscope observation is possible.

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PRIOR ART

[Description of the Prior Art] A slit lamp microscope projects slit light towards optometry-ed, is equipment which carries out expansion observation of the object part illuminated by this slit light by the stereomicroscope, and is widely used in the ophthalmology field. In observation by the conventional slit lamp microscope, when the optic media in an eye had turbidity, the slit light projected by this turbidity carried out scatter reflection, the flare was applied, and there was a case where it was difficult to obtain the clear image of an object part. As a microscope for obtaining a clear image except for the scattered light, the kino microscope indicated by U.S. Pat. No. 4884880 and 4927254 is known. The equipment which attached the confocal scan optical system of this kino microscope in the microscope head of a slit lamp microscope is proposed. This equipment converts a microscope head and inserts a confocal scan unit between the objective lens of a slit lamp microscope, and the binocular section.

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EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to this invention, it can be easily used as a confocal scan microscope, without converting the existing slit lamp microscope. Moreover, it is not necessary to hurt the observation function which the attached slit lamp microscope has by moving a part of confocal scan microscope unit by this invention. Furthermore, since the confocal scan microscope unit of this invention has an original objective lens, it can obtain the confocal observation image of a high scale factor easily by replacing this objective lens with the thing of a high scale factor.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, since the above-mentioned equipment needed to convert the microscope head, the existing slit lamp microscope had the fault of not being attached. Moreover, since the confocal scan unit of the above-mentioned equipment is prepared between an objective lens and the binocular section, it is difficult for it to make a high scale factor. However, in observation for a low scale factor, since the contrast rise effectiveness of an image is small, the profitableness of confocal observation will be reduced considerably.
[0004] This invention makes it a technical technical problem to offer the slit lamp microscope with which the confocal scan image of a high scale factor is obtained, without adding large reconstruction to a slit lamp microscope in view of the fault of equipment conventionally [above-mentioned].

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MEANS

[Means for Solving the Problem] This invention is characterized by having the following configurations, in order to solve the above-mentioned technical problem.
(1) In the slit lamp microscope which has the slit illumination-light study system which carries out slit lighting of the optometry-ed, and the observation optical system containing the objective lens which observes the optometry-ed by which slit lighting was carried out The confocal scan microscope unit which has the light guide optical system which carries out a light guide in the account objective lens of back to front which made said rotating disc carry out image formation of the flux of light reflected in respect of observation examined the eyes to the illumination-light study system which carries out pinhole lighting of the examined the eyes observation side by the illumination light which illuminated the rotating disc with many pinholes and passed the rotating disc, It is characterized by having an anchoring means to attach this confocal scan microscope unit in front of said objective lens.
[0006] (2) The anchoring means of (1) is characterized by the ability to observe optometry-ed directly with said objective lens, when it has the maintenance device in which said confocal scan microscope unit is held free [escape and insertion to an observation optical path] from an observation optical path and said confocal scan microscope unit escapes from an observation optical path.
[0007] (3) The maintenance device of (2) is characterized by having a migration means to move to the rotation means or the upper part which said confocal scan microscope unit rotates.
[0008] (4) Light guide optical system of (1) is characterized by having a flux of light separation means to divide the flux of light into two behind said rotating disc.
[0009] (5) The flux of light separation means of (4) consists of two or more mirrors, and it is characterized by changing a solid angle by changing the physical relationship of two or more of these mirrors.

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EXAMPLE

[Example] Hereafter, one example of this invention is explained based on a drawing.
[Configuration of optical system] drawing 1 is drawing which looked at the optical system in the condition of being the schematic diagram showing the optical system of the equipment of an example, and having attached the confocal scan microscope unit 2 in the slit lamp microscope section 1, from width, and drawing 2 is drawing which looked at the optical system of drawing 1 from the top. In addition, although a slit lamp microscope is equipped with the slit illumination system which floodlights slit light to optometry-ed, since it puts on the location which is made to wind in this at the time of confocal scan observation, and does not become obstructive, the explanation is omitted.
[0011] (Confocal scan microscope unit) 3 is a source of the illumination light and 4 is a condensing lens. UV cut-off filter which cuts ultraviolet radiation with 5 [harmful to the optometry E-ed], and 6 are infrared cut-off filters which cut infrared light harmful to the optometry E-ed. 7 extracts, 8 is a polarizer and a polarizer 8 makes the illumination light from the light source 3 the linearly polarized light. 9 is a beam splitter. The optical system to the source 3 of the illumination light - a polarizer 8 is the optical system of an illumination system proper, and carries out coupling of an illumination system and the observation system by the beam splitter 9. 10 is a rotating disc with the pinhole of a large number spirally arranged considering a revolving shaft as a core, and is called the so-called Nipkow disk. The rotating disc 10 is located in the object side focus of the slit lamp microscope section 1 mentioned later. A rotating disc 10 carries out high-speed rotation by motor 10a.
[0012] 11 is Phi-RUDORENZU, 12 is a pentaprism and a pentaprism 12 carries out the operation which reverses an image. 13 is a mirror for changing an optical path. 14 is lambda/4 plate, and lambda/4 plate 14 changes into the light of the circular polarization of light the illumination light made into the linearly polarized light by the above-mentioned polarizer 8, and it changes the light of the circular polarization of light into the light of the linearly polarized light. 15 is an objective lens and an objective lens 15 establishes a rotating disc 10 and an examined the eyes observation side in a location [****]. An objective lens 15 consists of fixed lens 15a and migration lens 15b movable in the direction of an optical axis, and minute focal doubling can be performed by moving migration lens 15b.
[0013] 17 is an analyzer. The analyzer 17 is arranged so that the polarization shaft of a polarizer 8 and the polarization shaft may cross at right angles. Although the light of the circular polarization of light reflected in respect of observation changes to the linearly polarized light with lambda/4 plate 14, since polarization shaft orientation rotates 90 degrees with the illumination light at this time, an analyzer 17 can be passed. The reflected light in the front face of a rotating disc 10, Phi-RUDORENZU 11, and pentaprism 12 grade is altogether cut by the analyzer 17. 18 is a mirror.
[0014] 19 and 20 are flux of light division mirrors, and divide into two the flux of light reflected by the mirror 18. Thereby, a tester can do solid observation of the observation side examined [E] the eyes through the slit lamp microscope section 1. Moreover, since two flux of light division mirrors 20 change the solid angle of the 2 flux of lights divided by being movable to a longitudinal direction and changing physical relationship with the flux of light division mirror 19 with a knob

without illustration, the tester who looks into the slit lamp microscope section 1 can change a cubic effect. 21 is a windowpane.

[0015] (Slit lamp microscope section) 30 is an objective lens, behind the objective lens 30, the variable power lenses 31a and 31b, the image formation lenses 32a and 32b, the erecting prisms 33a and 33b, and field diaphragms 34a and 34b of a Uichi Hidari pair are arranged, and an observer observes the middle image formed in field diaphragms 34a and 34b with oculars 35a and 35b.

Three configurations of the attachment and detachment to a [attachment], next the slit lamp microscope section 1 of the confocal scan microscope unit 2 are explained based on drawing 3 .

[0016] As for what is shown in (a) of drawing 3 , posterior part 2a of the confocal scan microscope unit 2 is fixed to the lens-barrel of the slit lamp microscope section 1. Since a configuration exceptional in the configuration of this anchoring [itself] is unnecessary, that explanation is omitted. Anterior part 2b of the confocal scan microscope unit 2 of the slit lamp microscope section 1 is pivotable as a core, and a position suspends the revolving shaft shown by A to posterior part 2a according to a click device. At the time of slit lamp microscope observation, the optical path of the up to [from the front face of the objective lens 30 of the slit lamp microscope section 1] examined [E] the eyes is securable by locating unit anterior part 2b in the location shown by the dotted line.

[0017] Unit anterior part 2b can slide upward what is shown in (b) of drawing 3 to posterior part 2a. What is shown in (c) of drawing 3 can be rotated, as unit anterior part 2b makes a shaft 40 the center of rotation and an arrow head C shows.

[0018] The observation actuation is explained in the equipment of the above configurations. It is made to wind in a slit illumination system, the confocal scan microscope unit 2 is attached, and a confocal scan microscope unit is put on a confocal scan microscope observation location. If the power source of the confocal scan microscope unit 2 is switched on, while the source 3 of the illumination light will light up, motor 10a drives and a rotating disc 10 carries out high-speed rotation. It is condensed with a condensing lens 4, and the light from the source 3 of the illumination light is extracted through the UV cut-off filter 5 and the infrared cut-off filter 6, and condenses to 7. After light which carried out outgoing radiation of the drawing 7 is made into the linearly polarized light by the polarizer 8, it penetrates a beam splitter 9 and illuminates a rotating disc 10. It passes along Phi-RUDORENZU 11 and a pentaprism 12, it is reflected by the mirror 13, and the flux of light which carried out outgoing radiation of the pinhole of a rotating disc 10 changes the sense. The light of the linearly polarized light reflected by the mirror 13 forms many pinhole images in the observation side examined [E] the eyes through the objective lens group 15, after being changed into the circular polarization of light by passing along lambda/4 plate 14.

[0019] The light of the circular polarization of light scattered about in respect of observation examined the eyes changes to the linearly polarized light by passing along lambda/4 plate 14 again through the objective lens group 15, and the linearly polarized light is made into what those shaft orientations rotated 90 degrees to the illumination light at this time. Through a mirror 13, a pentaprism 12, and Phi-RUDORENZU 11, image formation of the light of this linearly polarized light can be carried out on a rotating disc 10, and it can pass along the pinhole on a rotating disc 10. It reflects by the beam splitter 9 and the light which passed through the pinhole of a disk 10 reaches an analyzer 17. Since the analyzer 17 is arranged so that the polarization shaft of a polarizer 8 and the polarization shaft may cross at right angles, the reflected light in the front face of a rotating disc 10, Phi-RUDORENZU 11, and pentaprism 12 grade is cut, and the light scattered about in respect of observation examined the eyes is passed.

[0020] After reflecting the light which passed along the analyzer 17 by the mirror 18, it is separated into the 2 flux of lights by the flux of light division mirrors 19 and 20, a windowpane 21 is passed, and a tester observes this through the optical system of the slit lamp microscope section 1 toward the objective lens 30 of the slit lamp microscope section 1. Although the light of only the field where the examined the eyes observation side illuminated by the pinhole on a rotating disc 10 was restricted passes through a pinhole again and reaches a tester eye, since a majority of these pinholes are spirally arranged on a rotating disc 10 and high-speed rotation of the rotating disc 10 is carried out by motor 10a, the whole examined the eyes observation side

will be scanned and a tester can observe the whole observation side. In addition, as for the rotational speed of the rotating disc 10 by motor 10a, it is desirable that it is more than the speed as which a tester eye does not sense a flicker by scan.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram showing the optical system of the equipment of an example, and is drawing which looked at the optical system in the condition of having attached the confocal scan microscope unit in the slit lamp microscope section, from width.
[Drawing 2] It is drawing which looked at the optical system of drawing 1 from the top.
[Drawing 3] It is drawing for explaining the configuration of attachment and detachment to the slit lamp microscope section of a confocal scan microscope unit.
[Description of Notations]
1 Slit Lamp Microscope Section
2 Confocal Scan Microscope Unit
3 Source of Illumination Light
10 Rotating Disc
10a Motor
15 Objective Lens
30 Objective Lens

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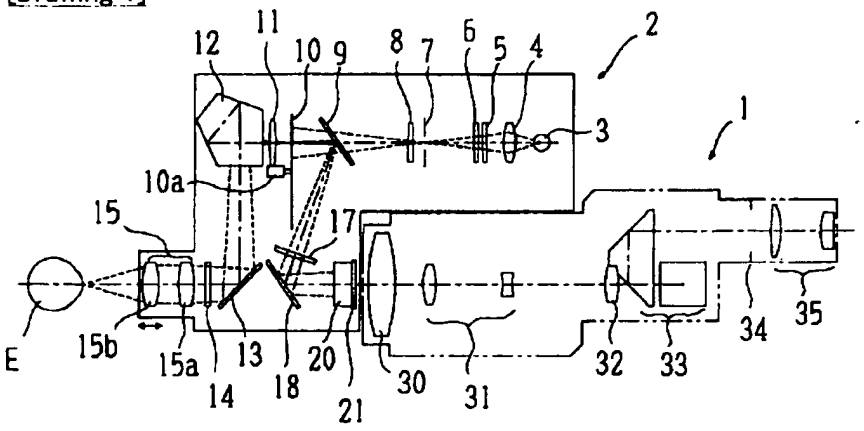
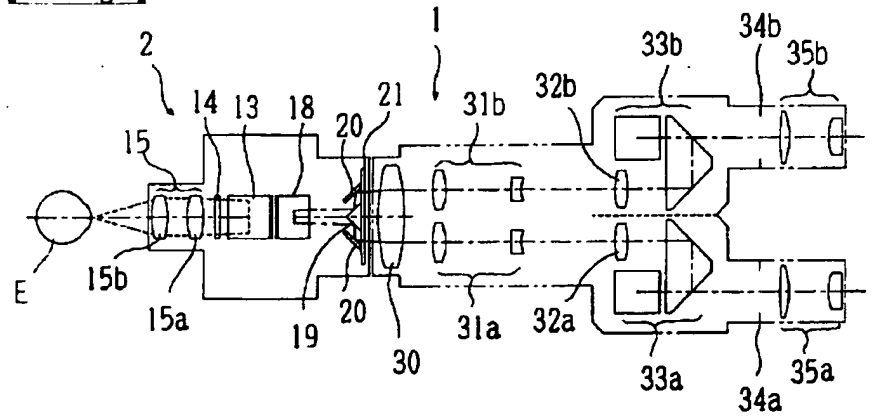
DRAWINGS

[Drawing 1]

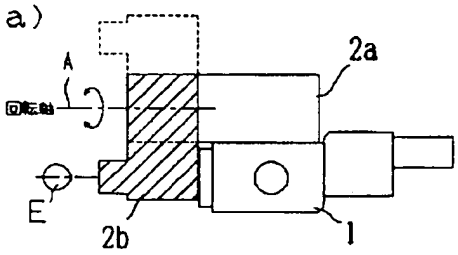


[Drawing 2]



[Drawing 3]

(a)



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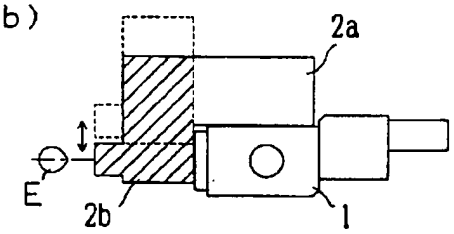
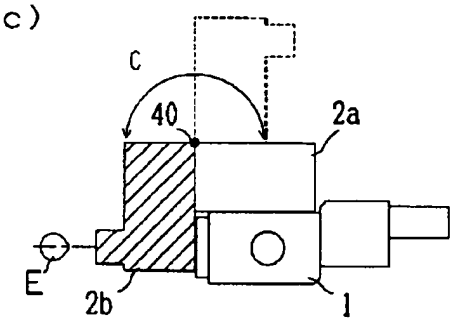


(c)



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(57)【要約】
【目的】細隙灯顕微鏡に大幅な改造を加えることなく、高倍率の共焦点走査像が得られる細隙灯顕微鏡を提供する。
【構成】被検眼をスリット照明するスリット照明光学系と、スリット照明された被検眼を観察する対物レンズを含む観察光学系とを有する細隙灯顕微鏡において、多数のピンホールを持つ回転円盤を照明し、回転円盤を通過した照明光により被検眼観察面をピンホール照明する照明光学系と被検眼観察面で反射した光束を前記回転円盤に結像させた後前記対物レンズに導光する導光光学系を持つ共焦点走査顕微鏡ユニットと、該共焦点走査顕微鏡ユニットを前記対物レンズの前に取付ける取付け手段と、を有することを特徴とする。

【特許請求の範囲】
【請求項1】被検眼をスリット照明するスリット照明光学系と、スリット照明された被検眼を観察する対物レンズを含む観察光学系とを有する細隙灯顕微鏡において、多数のピンホールを持つ回転円盤を照明し、回転円盤を通過した照明光により被検眼観察面をピンホール照明する照明光学系と被検眼観察面で反射した光束を前記回転円盤に結像させた後前記対物レンズに導光する導光光学系を持つ共焦点走査顕微鏡ユニットと、該共焦点走査顕微鏡ユニットを前記対物レンズの前に取付ける取付け手段と、を有することを特徴とする細隙灯顕微鏡。
【請求項2】請求項1の取付け手段は、前記共焦点走査顕微鏡ユニットを観察光路から脱出及び観察光路に挿入自在に保持する保持機構を持ち、前記共焦点走査顕微鏡ユニットが観察光路か

ら脱出したときは前記対物レンズにより直接被検眼が観察可能であることを特徴とする細隙灯顕微鏡。
【請求項3】請求項2の保持機構は、前記共焦点走査顕微鏡ユニットが回転する回転手段または上方に移動する移動手段を持つことを特徴とする細隙灯顕微鏡。
【請求項4】請求項1の導光光学系は、前記回転円盤の後方で光束を2つに分離する光束分離手段を持つことを特徴とする細隙灯顕微鏡。
【請求項5】請求項4の光束分離手段は複数のミラーから構成され、該複数のミラーの位置関係を変更することにより立体角を変えることを特徴とする細隙灯顕微鏡。

【発明の詳細な説明】
【0001】
【産業上の利用分野】本発明は、被検眼を観察する細隙灯顕微鏡に係り、さらに詳しくは共焦点走査顕微鏡観察が可能な装置に関する。
【0002】
【従来の技術】細隙灯顕微鏡は、被検眼に向けてスリット光を投射し、このスリット光により照明された対象部位を双眼実体顕微鏡で拡大観察する装置であり、眼科分野において広く使用されているものである。従来の細隙灯顕微鏡による観察では、眼内の中間透光体に混濁があると、この混濁により投射したスリット光が散乱反射してフレアがかかり、対象部位の鮮明な像を得ることが困難な場合があった。散乱光を除き鮮明な像を得るための顕微鏡としては、米国特許第4884880号及び同第4927254号に記載された、キノ顕微鏡が知られている。このキノ顕微鏡の共焦点走査光学系を細隙灯顕微鏡の顕微鏡ヘッド内に取り付けた装置が提案されている。この装置は、顕微鏡ヘッドを改造して共焦点走査ユニットを細隙灯顕微鏡の対物レンズと双眼部との間に挿入する。
【0003】
【発明が解決しようとする課題】しかしながら、上記装置は顕微鏡ヘッドを改造する必要があるので、既存の細隙灯顕微鏡には取り付けられないという欠点があった。また、上記装置の共焦点走査ユニットは対物レンズと双眼部との間に設けられているので、高い倍率を作り出すことが難しい。しかし、低倍率での観察では像のコントラストアップ効果が小さいので、共焦点観察の有利性をかなり減殺してしまう。
【0004】本発明は、上記従来装置の欠点に鑑み、細隙灯顕微鏡に大幅な改造を加えることなく、高倍率の共焦点走査像が得られる細隙灯顕微鏡を提供することを技術課題とする。
【0005】
【課題を解決するための手段】本発明は、上記課題を解決するために、次のような構成を持つことを特徴とする。
(1) 被検眼をスリット照明するスリット照明光学系と、スリット照明された被検眼を観察する対物レンズを含む観察光学系とを有する細隙灯顕微鏡において、多数のピンホールを持つ回転円盤を照明し、回転円盤を通過した照明光により被検眼観察面をピンホール照明する照明光学系と被検眼観察面で反射した光束を前記回転円盤に結像させた後前記対物レンズに導光する導光光学系を持つ共焦点走査顕微鏡ユニットと、該共焦点走査顕微鏡ユニットを前記対物レンズの前に取付ける取付け手段と、を有することを特徴とする。
【0006】(2) (1)の取付け手段は、前記共焦点走査顕微鏡ユニットを観察光路から脱出及び観察光路に挿入自在に保持する保持機構を持ち、前記共焦点走査顕微鏡ユニットが観察光路から脱出したときは前記対物レンズにより直接被検眼が観察可能であることを特徴とする。
【0007】(3) (2)の保持機構は、前記共焦点走査顕微鏡ユニットが回転する回転手段または上方に移動する移動手段を持つことを特徴とする。
【0008】(4) (1)の導光光学系は、前記回転円盤の後方で光束を2つに分離する光束分離手段を持つことを特徴とする。
【0009】(5) (4)の光束分離手段は複数のミラーから構成され、該複数のミラーの位置関係を変更することにより立体角を変えることを特徴とする。
【0010】
【実施例】以下、本発明の一実施例を図面に基づいて説明する。
[光学系の構成]図1は実施例の装置の光学系を示す概略図であり、細隙灯顕微鏡部1に共焦点

走査顕微鏡ユニット2を取り付けた状態の光学系を横から見た図であり、図2は図1の光学系を上から見た図である。なお、細隙灯顕微鏡はスリット光を被検眼に投光するスリット照明系を備えるが、共焦点走査観察時にはこれを回旋させて邪魔にならない位置に置くので、その説明は省略している。

【0011】(共焦点走査顕微鏡ユニット)3は照明光源であり、4はコンデンサレンズである。5は被検眼Eに有害な紫外光をカットするUVカットフィルタ、6は被検眼Eに有害な赤外光をカットする赤外カットフィルタである。7は絞り、8はポラライザであり、ポラライザ8は光源3からの照明光を直線偏光にする。9はビームスプリッタである。照明光源3～ポラライザ8までの光学系が照明系固有の光学系であり、ビームスプリッタ9により照明系と観察系をカップリングする。10は回転軸を中心として渦巻状に配置された多数のピンホールを持つ回転円盤であり、いわゆるニポーディスクと呼ばれるものである。回転円盤10は後述する細隙灯顕微鏡部1の物側焦点に位置している。回転円盤10はモータ10aにより高速回転する。

【0012】11はフィールドレンズ、12はペンタプリズムであり、ペンタプリズム12は像を反転させる作用をする。13は光路を変えるためのミラーである。14はλ／4板であり、λ／4板14は前述のポラライザ8により直線偏光とされた照明光を円偏光の光に変え、円偏光の光を直線偏光の光に変える。15は対物レンズであり、対物レンズ15は回転円盤10と被検眼観察面とを共役な位置に置く。対物レンズ15は固定レンズ15aと光軸方向に移動可能な移動レンズ15bとからなり、移動レンズ15bを動かすことにより微小なフォーカス合わせを行うことができる。

【0013】17はアナライザである。アナライザ17はその偏光軸がポラライザ8の偏光軸と直交するように配置してある。観察面で反射した円偏光の光はλ／4板14により直線偏光に変わるが、このとき偏光軸の方向は照明光とは90度回転するので、アナライザ17を通過することができる。回転円盤10、フィールドレンズ11及びペンタプリズム12等の表面での反射光はアナライザ17により全てカットされる。18はミラーである。

【0014】19、20は光束分割ミラーであり、ミラー18で反射してきた光束を2つに分離する。これにより、検査者は細隙灯顕微鏡部1を介して被検眼Eの観察面を立体観察することができる。また、2つの光束分割ミラー20は図示なきツマミにより左右方向に移動可能であり、光束分割ミラー19との位置関係を変えることにより分割した2光束の立体角が変わるため細隙灯顕微鏡部1を覗く検査者は立体感を変更することができる。21は窓ガラスである。

【0015】(細隙灯顕微鏡部)30は対物レンズであり、対物レンズ30の後方には左右一対の変倍レンズ31a, 31b、結像レンズ32a, 32b、正立プリズム33a, 33b及び視野絞り34a, 34bが配置されており、観察者は視野絞り34a, 34bに形成された中間像を接眼レンズ35a, 35bによって観察する。

[アタッチメント]次に、共焦点走査顕微鏡ユニット2の細隙灯顕微鏡部1への着脱の構成を図3に基づいて3例説明する。

【0016】図3の(a)に示すものは、共焦点走査顕微鏡ユニット2の後部2aが細隙灯顕微鏡部1の鏡筒に固定される。この取付け自体の構成には格別な構成は必要ないので、その説明は省略する。細隙灯顕微鏡部1の共焦点走査顕微鏡ユニット2の前部2bは後部2aに対してAで示す回転軸を中心として回転可能であり、クリック機構により所定の位置に停止される。細隙灯顕微鏡観察時には点線で示す位置にユニット前部2bを位置させることにより、細隙灯顕微鏡部1の対物レンズ30の前面から被検眼Eまでの光路を確保することができる。

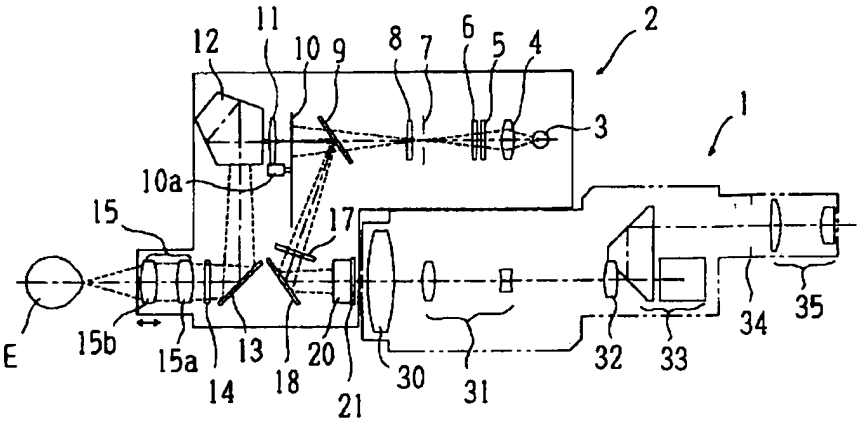
【0017】図3の(b)に示すものは、ユニット前部2bが後部2aに対して上方向にスライド可能である。図3の(c)に示すものは、ユニット前部2bが軸40を回転中心として矢印Cで示すように回転移動可能である。

【0018】以上のような構成の装置において、その観察動作を説明する。スリット照明系を回旋させて、共焦点走査顕微鏡ユニット2を取り付け、共焦点走査顕微鏡ユニットを共焦点走査顕微鏡観察位置に置く。共焦点走査顕微鏡ユニット2の電源を投入すると、照明光源3が点灯するとともに、モータ10aが駆動して回転円盤10が高速回転する。照明光源3からの光はコンデンサレンズ4で集光され、UVカットフィルタ5及び赤外カットフィルタ6を介して絞り7に集光する。絞り7を出射した光はポラライザ8により直線偏光にされた後、ビームスプリッタ9を透過して回転円盤10を照明する。回転円盤10のピンホールを出射した光束は、フィールドレンズ11およびペンタプリズム12を通り、ミラー13で反射されて向きを変える。ミラー13で反射した直線偏光の光はλ／4板14を通ることにより円偏光に変えられた後、対物レンズ群15を通って被検眼Eの観察面に多数のピンホール像を形成する。

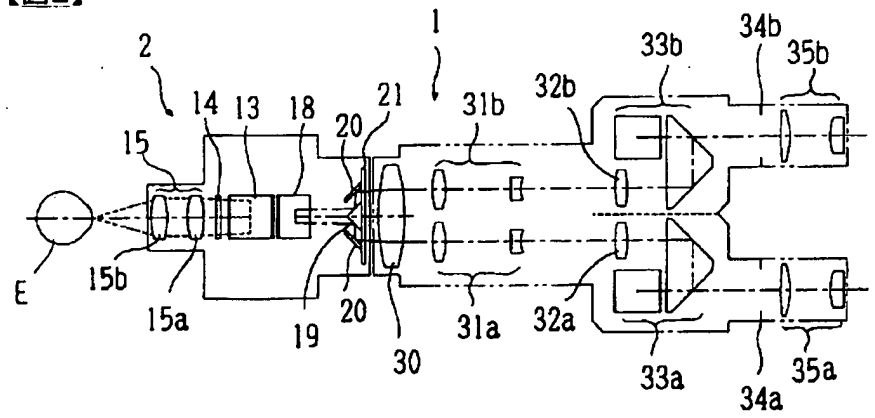
【0019】被検眼観察面で散乱した円偏光の光は、対物レンズ群15を介して再びλ／4板14を通ることにより直線偏光に変わり、このとき直線偏光はその軸方向が照明光に対して90度回転したものにされる。この直線偏光の光は、ミラー13、ペンタプリズム12およびフィールドレンズ11を経て、回転円盤10上に結像し、回転円盤10上のピンホールを通ることができる。円盤10のピンホールを通過した光はビームスプリッタ9で反射し、アナライザ17に届く。アナライザ17はその偏光軸がポラライザ8の偏光軸と直交するように配置してあるので、回転円盤10、フィールドレンズ11及びペンタプリズム12等の表面での反射光をカットし、被検眼観察面で散乱した光を通過させる。
【0020】アナライザ17を通った光は、ミラー18で反射した後、光束分割ミラー19、20により2光束に分離され、窓ガラス21を通過して細隙灯顕微鏡部1の対物レンズ30に向かい、検査者は細隙灯顕微鏡部1の光学系を介してこれを観察する。回転円盤10上のピンホールにより照明された被検眼観察面の限られた領域のみの光がまたピンホールを通過して検査者眼に届くが、このピンホールは回転円盤10上に渦巻状に多数配置され、かつ、回転円盤10はモータ10aにより高速回転されるので、被検眼観察面全体が走査されることになり、検査者は観察面の全体を観察することができる。なお、モータ10aによる回転円盤10の回転速度は、検査者眼が走査によるちらつきを感じることがない速さ以上であることが望ましい。
【0021】
【発明の効果】以上、本発明によれば、既存の細隙灯顕微鏡を改造することなく、容易に共焦点走査顕微鏡として使用することができる。また、本発明による共焦点走査顕微鏡ユニットの一部を動かすことで、取り付けた細隙灯顕微鏡が持つ観察機能を損なわせずにすむ。さらに本発明の共焦点走査顕微鏡ユニットは独自の対物レンズを持つため、この対物レンズを高倍率のものに代えることにより容易に高倍率の共焦点観察像を得ることができる。

【図面の簡単な説明】
【図1】実施例の装置の光学系を示す概略図であり、細隙灯顕微鏡部に共焦点走査顕微鏡ユニットを取り付けた状態の光学系を横から見た図である。
【図2】図1の光学系を上から見た図である。
【図3】共焦点走査顕微鏡ユニットの細隙灯顕微鏡部への着脱の構成を説明するための図である。
【符号の説明】
1 細隙灯顕微鏡部
2 共焦点走査顕微鏡ユニット
3 照明光源
10 回転円盤
10a モータ
15 対物レンズ
30 対物レンズ

【図1】

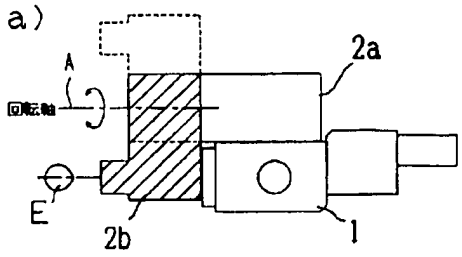

12
11
10
9
8
7
6
5
4
2
3
1
10a
15
17
E
15b
15a
13
20
14
18
21
30
31
32
33
34
35

【図2】

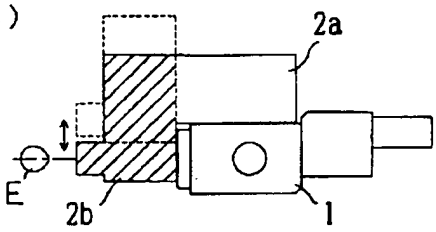

2
1
34b
33b
35b
14
13
18
21
20
31b
32b
15
E
15b
15a
19
20
30
31a
32a
33a
34a
35a

【図3】

(a)



(b)



(c)